DARPA Grand Challenge
Technical Paper Requirements

A technical paper describing a team's technical approach for competing in the Grand Challenge is required to participate. Please refer to the Grand Challenge Rules at www.darpa.mil/grandchallenge/rules.htm for further information about the purpose and handling of the technical papers.

Papers must be typewritten in a font no smaller than twelve-point, single spaced, with one inch margins on all sides. The maximum allowable length is ten single-sided 8.5 by 11 inch pages, exclusive of any cover pages, diagrams, or attachments. The cover page should include the team name and contact information for the team leader.

Submission of technical papers in an electronic format is required. Papers should be submitted via Email to grandchallenge@darpa.mil, or on a PC formatted CD, 3.5 inch diskette, or Zip disk. Only Microsoft Word (.doc), Adobe (.pdf), text (.txt), and rich text format (.rtf) files will be accepted.

The technical paper must address the areas outlined below. If a particular requirement is not applicable due to the uniqueness of the system design, the paper must demonstrate why that question does not apply. Teams that submit technical papers that do not sufficiently address the required technical areas will be asked for amplification. Technical papers that do not appear credible, or appear to be unsafe or in violation of any of the Grand Challenge rules, will also not be approved. Papers that are not originally approved may be resubmitted at any time before the application deadline.

Any significant deviation from the design and specifications outlined in a technical paper must be submitted to DARPA for approval via a technical paper addendum. Technical paper addenda can be submitted at any time prior to 27 February 2004. Technical paper addenda should be submitted in the same format as the technical paper.

Required Contents

1. System Description
   a. Mobility.
      1. Describe the means of ground contact. Include a diagram showing the size and geometry of any wheels, tracks, legs, and/or other suspension components.
      2. Describe the method of Challenge Vehicle locomotion, including steering and braking.
      3. Describe the means of actuation of all applicable components.
   b. Power.
      1. What is the source of Challenge Vehicle power (e.g., internal combustion engine, batteries, fuel cell, etc.)?
      2. Approximately how much maximum peak power (expressed in Watts) does the Challenge Vehicle consume?
      3. What type and how much fuel will be carried by the Challenge Vehicle?
   c. Processing.
      1. What kind of computing systems (hardware) does the Challenge Vehicle employ? Describe the number, type, and primary function of each.

2. Describe the methodology for the interpretation of sensor data, route planning, and vehicle control. How does the system classify objects? How are macro route planning and reactive obstacle avoidance accomplished? How are these functions translated into vehicle control?

d. Internal Databases.
   1. What types of map data will be pre-stored on the vehicle for representing the terrain, the road network, and other mobility or sensing information? What is the anticipated source of this data?

e. Environment Sensing.
   1. What sensors does the challenge vehicle use for sensing the environment, including the terrain, obstacles, roads, other vehicles, etc.? For each sensor, give its type, whether it is active or passive, its sensing horizon, and its primary purpose.
   2. How are the sensors located and controlled? Include any masts, arms, or tethers that extend from the vehicle.

f. State Sensing.
   1. What sensors does the Challenge Vehicle use for sensing vehicle state?
   2. How does the vehicle monitor performance and use such data to inform decision making?

g. Localization.
   1. How does the system determine its geolocation with respect to the Challenge Route?
   2. If GPS is used, how does the system handle GPS outages?
   3. How does the system process and respond to Challenge Route boundaries?

h. Communications.
   1. Will any information (or any wireless signals) be broadcast from the Challenge Vehicle? This should include information sent to any autonomous refueling/servicing equipment.
   2. What wireless signals will the Challenge Vehicle receive?

i. Autonomous Servicing
   1. Does the system refuel during the race? If so, describe the refueling procedure and equipment.
   2. Are any additional servicing activities planned for the checkpoint? If so, describe function and equipment.

j. Non-autonomous control. How will the vehicle be controlled before the start of the challenge and after its completion? If it is to be remotely controlled by a human, describe how these controls will be disabled during the competition.

2. System Performance
   a. Previous Tests. What tests have already been conducted with the Challenge Vehicle or key components? What were the results?
   b. Planned Tests. What tests will be conducted in the process of preparing for the Challenge?

3. Safety and Environmental Impact
   a. What is the top speed of the vehicle?
   b. What is the maximum range of the vehicle?
   c. List all safety equipment on-board the Challenge Vehicle, including:
      1. Fuel containment
      2. Fire suppression
      3. Audio and visual warning devices
   d. E-Stops.
      1. How does the Challenge Vehicle execute emergency stop commands? Describe in detail the entire process from the time the on-board E-Stop receiver outputs a stop signal to the time the signal is cleared and the vehicle may proceed. Include descriptions of both the software controlled stop and the hard stop.

2. Describe the manual E-Stop switch(es). Provide details demonstrating that this device will prevent unexpected movement of the vehicle once engaged.
3. Describe in detail the procedure for placing the vehicle in "neutral", how the "neutral" function operates, and any additional requirements for safely manually moving the vehicle. Is the vehicle towable by a conventional automobile tow truck?

e. Radiators.
   1. Itemize all devices on the Challenge Vehicle that actively radiate EM energy, and state their operating frequencies and power output. (E.g., lasers, radar apertures, etc.)
   2. Itemize all devices on the Challenge Vehicle that may be considered a hazard to eye or ear safety, and their OSHA classification level.
   3. Describe any safety measures and/or procedures related to all radiators.

f. Environmental Impact.
   1. Describe any Challenge Vehicle properties that may conceivably cause environmental damage, including damage to roadways and off-road surfaces.
   2. What are the maximum physical dimensions (length, width, and height) and weight of the vehicle?
   3. What is the area of the vehicle footprint? What is the maximum ground pressure?